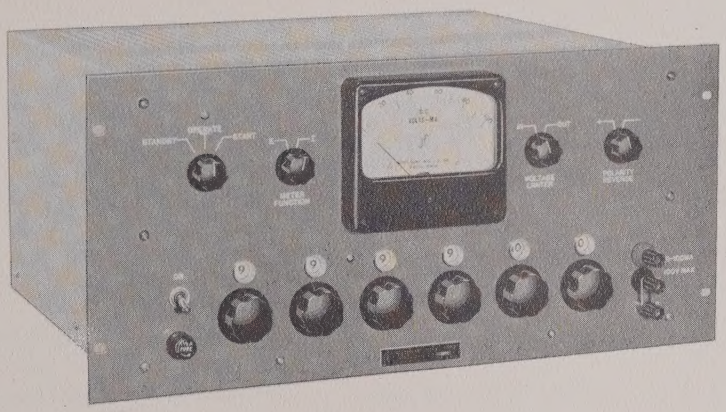
FLUKE

TECHNICAL DATA

351A POWER SUPPLY



FEATURES

- High Accuracy and Stability
- Close regulation of Output
- 0.1 Microampere Current Resolution
- Six Dial in-line Readout, Reads Directly in Milliamperes
- Rapid Selection of Output Current
- Two Over-voltage Protection Circuits

APPLICATIONS

Calibration and Testing of -

1) Instruments
2) Microammeters and Milliammeters
3) Semiconductors
4) Torque Motors
5) Bolometers
6) Sensitive DC Relays

DESCRIPTION

Model 351A is a multi-purpose constant current power supply which provides a closely regulated output of 1.0 microamperes to 100 milliamperes in 0.1 microampere increments. Current output level is easily set with six decade switches arranged to provide convenient in-line readout with illuminated decimal point.

A standard cell reference and chopper stabilization of the DC amplifier impart to the 351A excellent output current stability and almost complete isolation from effect of line voltage and load resistance changes.

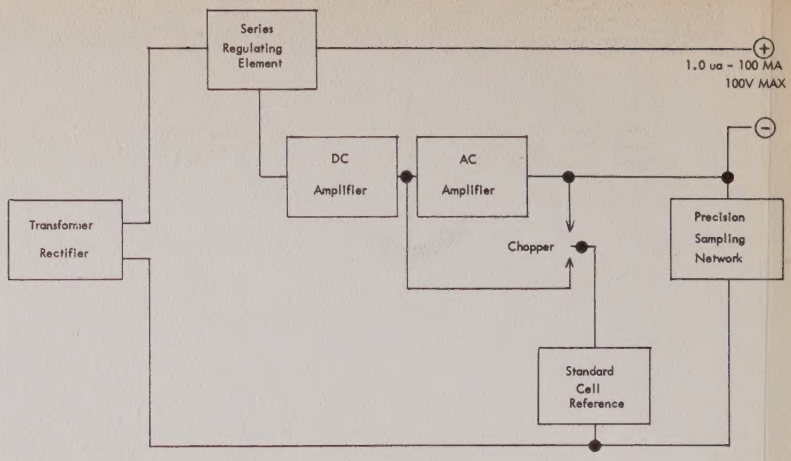
Unique barrier construction isolates the standard cell and precision wirewound resistor current sampling strings from all heat generating elements.

A voltage limiting circuit in the Model 351A provides maximum protection when used to calibrate meters. With the limiter in, the output voltage will not rise above 600 millivolts. With the limiter out, the instrument automatically is placed in standby condition if the output voltage attempts to rise above 120 volts.

Highest quality components are used to insure trouble-free operation.

MODEL 351A

SIMPLIFIED BLOCK DIAGRAM



ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 117/220/234 volts ±10%, 50-60 cps, single phase.

INPUT POWER: 125 watts fully loaded, 75 watts standby.

OUTPUT CURRENT: 1.0 UA - 100 MA in 0.1 UA steps.

OUTPUT VOLTAGE: 0 - 100 volts maximum.

VOLTAGE LIMITER: Panel switch selected: limits output voltage to 600 MV providing automatic protection for meter calibration (calibration accuracy specification applies only up to 300 MV with voltage limiter circuit operative).

OVER-VOLTAGE PROTECTION: Over-voltage circuit automatically places unit in standby condition when output voltage tends to rise above 120 volts.

OUTPUT POLARITY: Positive or negative grounded, or floating (output polarity may be reversed with front panel switch).

OUTPUT CONNECTORS: Front panel insulated binding posts on 3/4" centers and terminal strip on rear skirt.

REGULATION vs. LINE: 0.01% or 0.1 microampere, whichever is greater, for 10 volt line change.

REGULATION vs. LOAD: 0.01% or 0.1 microampere, whichever is greater, for load resistance change from zero to maximum.

STABILITY: 0.005% per hour after short warmup, 0.01% per day.

RIPPLE: 0.05% plus 1.0 microampere. (RMS)

MAXIMUM LOAD RESISTANCE: 50 K ohms (maximum load resistance at any current setting, must be consistent with maximum voltage allowable across load).

CALIBRATION ACCURACY: 0.05% +0.5 microampere.

CURRENT RESOLUTION: 0.1 microampere.

READOUT: 6 dial in-line with illuminated decimal point, reads directly in milliamperes.

METER: 4-1/2" rectangular mounted with switch for selectively reading voltage and current.

MECHANICAL SPECIFICATIONS

DIMENSIONS: 8-3/4" rack panel, 19" wide, 14" deep. Equipped with resilient feet for bench use.

WEIGHT: 35 pounds.

PRICE: $845.00, f.o.b. factory, Mountlake Terrace, Washington.

The right is reserved, without notice, to make such changes in equipment, design, or components as engineering or manufacturing progress may warrant.

Prices subject to change without notice.

9-20-61

Litho in U. S. A.

Electronics FOR INDUSTRY

FLUKE

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MODEL 351A

TEST PROCEDURE

A. VISUAL INSPECTION

1. Check front panel engraving for accuracy and quality. Check that 117-234V connection decal, rear fanning strip identification decal, and tube location decal are attached to instrument.

2. Check front panel controls to insure that all knobs are tight and properly oriented, and that moving parts do not bind.

3. Check placement of all components on front panel and on main chassis, with emphasis on proper attachment and quality of workmanship.

4. Check all solder joints.

5. Check appearance of all harnesses, with emphasis on proper routing and quality of workmanship.

B. PRELIMINARY CHECKS

1. Resistance.

   (a) Remove shorting link between negative binding post and G post. Resistance between negative binding post and chassis and positive binding and chassis must be infinite.

   (b) Measure resistance across C1. Should be 150K.

   (c) Measure resistance across C6. Should be 150K.

   (d) Measure resistance across C7A and C7B. Should be greater than 500K.

   (e) Measure resistance across C11A and C11B. Should be greater than 500K.

   (f) Turn front panel dials to 0-0-0-0-1. Measure resistance from negative binding post to internal negative. Should be 1 M. Rotate last dial CW, noting that resistance changes to 500K, 333K, 250K, 200K, 167K, 143K, 125K, 111K, and 100K. Then rotate next to last dial CW noting that resistance changes to 50K, 33K, 25K, 20K, 16.7K, 14.3K, 12.5K, 11.1K, and 10K. Rotate third dial CW noting that resistance changes to 5K, 3.3K, 2.5K, 2K, 1.67K, 1.43K, 1.25K, 1.11K and 1.0K. Rotate second from left dial CW noting that resistance changes to 500, 333, 250, 200, 167, 143, 125, 111, and 100. Rotate left dial CW noting that resistance changes to 60, 43, 35, 30, 26.7, 24.3, 22.5, 21.1 and 20.

   (g) Check that there is continuity between front panel binding posts and appropriate terminals of rear fanning strip.

2. Input Power.

   Set power variac to 0 and turn instrument on. Slowly increase variac setting while monitoring input power. Input power should never exceed 70 watts. Increase variac setting to 117V. Input power should be 55 to 65 watts. Monitor input power while continuing preliminary checks and be alert for smoke or other evidence of trouble. Increase variac setting to 130V and check for any failure. Return variac setting to 117V for remaining checks.

3. Voltage measurements (with respect to internal negative).

   (a) +200V Aux:
   Ek V5 (pin 2, 6AQ5, should be +200V)

   (b) -200V Aux:
   Pin 2 of V13 should be -200V

   (c) Screen supply (change negative lead of voltmeter to positive binding post).
   Voltage across C6 should be 320V

4. Unplug standard cell. Check that CK2 and CK3 pull in by depressing the large blade of CK1 nearest the heat barrier. CK2 and CK3 should drop out when this blade is released.

5. Measure voltage from junction of R62 and R63 to internal negative. Should be 0.02V.
   Connect standard cell.

6. Main supply initial operation
   Set current controls to 0-9-9-9-10 (10ma)
   Set voltage limiter to IN
   Set meter function to I
   Rotate standby, operate, start switch (S1) to start and release. Meter should indicate approximately 10 ma and light over OPERATE should be on.
   Turn meter function to E. Meter should read 1V.

C. BAKE

Switch voltage limiter to IN. Turn S1 through START to OPERATE. Let instrument operate at normal line voltage for not less than 24 hours with 100 ma dialed.

D. PRE-CALIBRATION CHECKS

1. +200V Aux:

   (a) Eb V5 (6AQ5, pin 5, 6) should be 350V

   (b) ep V5 should be less than 1V

   (c) ek V5 should be 5 mv or less

   (d) Line voltage at which +Aux. drops out. Should be less than 100V.

   (e) Vary input voltage from 100-130V. Ek of V5 should be less than 400 mv.

2. -200V Aux:

   (a) Eb V9 (6AQ5, pin 5, 6) should be 350V.

   (b) ep V9 should be less than 1V.

   (c) ek V9 should be 5 mv or less.

   (d) Line voltage at which Aux. drops out. Should be less than 100V.

   (e) Vary input voltage from 100-130V. Ek of V9 should be less than 400 mv.

3. (a) Check DC at plates of 6CA7's. Should be 250V.

   (b) Check AC at plates of 6CA7's. Should be less than 4V.

4. Check plate and screen voltages of V17 and V16.
   Check plate, grid, and cathode voltages of V15, V14 and V19.

5. Reference Circuit:
   Check voltage at V18, pin 2, 4, 7. Should be 83-86V.
   Check regulation of voltage at this point for 100-130V line change.
   Must be less than 10 mv.

6. AC amplifier minimum adjustment:
   Connect AC VTVM from plate (pin 5, V16) to internal negative. Adjust P1 for minimum reading. Should be less than 9V, about 3V.

7. Calibration adjustment:
   Connect 10 ohm resistor across positive and negative binding posts. Switch voltage limiter to OUT. Dial 9-9-9-9-10 and adjust P2 so that voltmeter (801) or potentiometer across 10 ohm resistor reads 1.00000V.

8. Linearity:
   Check voltage (with potentiometer) across 10 ohm resistor as first three dials are rotated to zero. Maximum error should be less than 0.03%. Use 100 ohm resistor for 10 ma and lower.

9. Meter Calibration:

   (a) With meter function turned to I and 100 ma dialed, adjust meter shunt for full scale. NOTE: When making adjustment, switch unit to standby.

   (b) Check linearity by dialing 90, 80, 70, 60, 50, 40, 30, 20, 10 ma. Error should not be greater than 1-1/2 small divisions.

   (c) Switch meter function to E and dial 100 ma with 1K load. Meter should read 100V. Check linearity by changing output current to 90, 80. 70, 60, 50, 40, 30, 20, 10 ma. Error should be less than 1-1/2 small divisions.

10. Check over-voltage at which CK4 pulls in. Dial 10 ma with 10K load. Increase load current in steps of 0.1 ma. CK4 should pull in at 11 ma to 12 ma.

    PUT COVER ON.

11. Line Regulation:
    Use 10 ohm resistor and potentiometer, 100 ohm for 10 ma and lower. Check reading for 100-117-130V line. Change from 100-130V should be less than 0.02%. Take readings at 100 ma, 10 ma, 1 ma, 0.1 ma.

12. Load Regulation:
    Connect variable load resistance in series with 10 ohm (or 100 ohm for 10 ma and lower) resistor. Check voltage across fixed resistor and ripple across binding posts as specified in test report.

13. Voltage Limiter:
Use 10 ohm resistor as load, and potentiometer. Dial 30 ma and compare reading with VOLTAGE LIMITER OUT to reading with VOLTAGE LIMITER IN.

E. FINAL CALIBRATION AND STABILITY

1. Recheck AC amplifier minimum adjustment as in step D-6.

2. Put cover on. Reset P2 as in step D-7.

3. Check stability of 100 ma setting for 2 hours.

351A

DC VOLTAGES/ZERO BUS

PIN

	1	2	3	4	5	6	7	8
V-1/-2			215 ± 10%	Across C-6 250 ± 10%	-12 to -20			
V-14	125 ± 5%			-115 to -130	-125	-67 to -73		-12 to -20
V-15	60-70	+.45 to +.55				60-75	+.2 to +.8	
V-16	-1.16				55-72	30-45		
V-17	-1.2				55-72	30-45		

351A Test Report

Date _____ Serial No. _____

Technician _____

A. VISUAL INSPECTION	Limits	Reading	Remarks
1. Engraving, Decals	OK		
2. Controls	OK		
3. Components	OK		
4. Solder Joints	OK		
5. Harnesses	OK		
B. Preliminary Checks			
1. Resistance Readings			
a. Neg. to G Post	Infinite		
b. Across C1	150K ± 5%		
c. Across C6	150K ± 5%		
d. Across C7A & B	MT 500K		
e. Across C11A & B	MT 500K		
f. Sample Resistors	See Text		
g. Binding Posts to Term. strip continuity	0 ohm		
2. Input Power	55-65 Watts		
3. Voltage Measurements			
a. Filament Regulator	-11.5 to -12.9V		
b. +190V Aux.	181 to 220V		
c. -190V Aux.	-181 to - 220V		
d. Screen supply	305 to 335V		
4. CK2 & CK3 Pull-in	OK		
5. .02V Reg.	-.018 to -0.22V		
6. Main Supply Operation	OK		
7. Meter Cal.			
a. Set Shunt for F.S. I	LT 1 sd		

Preliminary Checks (con'd)	Limits	Reading	Remarks
b. I Scale Linearity	LT 1-1/2 sd		
c. E F.S.	LT 1-1/2 sd		
8. Load Voltage for CK4 Pull-in	105-125V		
9. AC Amp. Min. Adj.	LT 3-9V		
10. Ripple Adjust, 1 ua, 50K Load	LT 25 mv		With shorting link ON or OFF, with Line Cord Connected to ground
Bake (24 Hours Minimum)	None		